Chapter 5
Energy and the Environment

Decisions on meeting future energy needs should no longer be based only on traditional economic models; they can also incorporate protection of ecosystems, natural resources, and the health and well-being of citizens.

5.0 Energy and the Environment

Virginia citizens rely on energy to power their homes and businesses, fuel their mobility, and support their quality of life. However, pollution caused by the combustion of fossil fuels has detrimental effects on Virginia's climate and air and water quality, and can affect the health of its citizens and wildlife. Mineral extraction and the development of utility infrastructure can also impose an environmental burden by altering Virginia's rural landscapes and aquatic habitats. Virginia's energy policy recognizes the imperative to constantly strive for an appropriate balance between the environmental costs of energy production and use and the benefits to our economy and our way of life.

Decisions on meeting future energy needs should no longer be based only on traditional economic models; they can also incorporate protection of ecosystems, natural resources, and the health and well-being of citizens. By using materials and water more efficiently and employing reuse and recycling, we can reduce the energy required to produce and process materials and to treat water.

Virginia can join in the transition to a greener energy future by pursuing emerging energy production technologies, increasing conservation and the use of renewable resources, and improving energy efficiency.

Energy production practices can have a positive effect on the environment by reducing energy use and the resulting environmental impacts. Biofuel production can provide a new market for farmers who make agricultural uses of land more economically sustainable and could be a source of revenue to implement water-quality best management practices. Production of cellulosic energy crops may produce less agricultural runoff than other crops. Production of algae as an energy feedstock can be used to reduce nutrients in Virginia's waterways. Renewable energy production that offsets conventional energy production can reduce pollution as compared with traditional energy sources. Carbon capture and storage need to be further developed to reduce the carbon emissions from conventional energy production.

5.1 Impacts of Energy Use on Climate Change

Strong evidence exists that increasing emissions of carbon dioxide and other greenhouse gases are affecting Earth's climate. The Intergovernmental Panel on Climate Change's *Fourth Assessment Report* stated, with an increased confidence level over previous reports, that most of the observed increase in globally averaged temperatures since the mid-twentieth century is "very likely due" to the increased anthropogenic greenhouse gas concentrations.[83]

Carbon dioxide emissions rose in Virginia by approximately 34 percent from 1990 to 2004, a rate nearly twice the national average. This increase results, in part, from growth in Virginia's economy and development patterns that have produced sprawl and long commutes. A 30 percent increase in gasoline-powered cars during this period ranked Virginia in the top ten states. The current science suggests that many changes can be expected from the cumulative effects of human-related emissions of carbon dioxide and other greenhouse gases affecting weather patterns, wildlife habitat, food production, and water supplies.[84]

What does climate change mean for Virginia? Over the long term, climate change will affect Virginia's people, wildlife, and economy. The Virginia Institute for Marine Science estimates that the Mid-Atlantic sea level will rise between 4 and 12 inches by 2030, threatening coastal islands and low-lying areas. Air and sea temperature changes would cause more frequent tropical storms, with increased damage to Virginia communities. Changing rain and temperature patterns would disrupt agriculture and forestry.

Carbon dioxide emissions can be reduced

[83] See the EPA website www.epa.gov/climatechange/science/stateofknowledge.html ; report from the Greenhouse Gas Working Group of the State Advisory Board on Air Pollution, January 5, 2007 (www.deq.virginia.gov/air/sab/GHGreport.doc); and Intergovernmental Panel on Climate Change, "Climate Change 2007: The Physical Science Basis; Summary for Policymakers" (www.ipcc.ch/SPM2feb07.pdf)

[84] The six primary greenhouse gases listed in the Kyoto Protocol are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydroflurocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6) (http://europa.eu/scadplus/leg/en/lvb/l28060.htm).

Methane is a major source of greenhouse gases. According to the U.S. Environmental Protection Agency (EPA), methane is more than twenty times more effective at trapping heat in the atmosphere than carbon dioxide over a hundred-year period.

by increasing energy efficiency and conservation and using energy from sources that generate less carbon dioxide such as nuclear, hydropower, solar, wind, and biomass energy with a closed carbon cycle. Future technologies may permit widespread, cost-effective capture and storage of carbon.

A January 2007 report from the Greenhouse Gas Working Group of the State Advisory Board on Air Pollution provided an overview of greenhouse gases, including their sources and emissions in Virginia. The report listed policy options but did not make specific recommendations. The report noted that (i) the principal greenhouse gas from human activities is carbon dioxide, largely because these emissions are many times greater than any other greenhouse gas; (ii) the United States is responsible for about 25 percent of global carbon dioxide emissions; (iii) burning fossil fuels accounts for about 80 percent of U.S. greenhouse gas emissions; (iv) reducing greenhouse gas emissions and carbon capture and storage are two ways to address the problem of global warming caused by greenhouse gases; and (v) because transportation accounts for 40 percent of carbon dioxide emissions, the transportation sector is one of the most promising areas for carbon dioxide emissions reductions.

One technology that may be available in the near term is advanced coal gasification with carbon capture. Carbon may also be removed from the atmosphere by biological means in forests and grasslands. Replanting and conservation of forestland and grassland is one of the options open to Virginia to capture and store carbon.

Methane is another major source of greenhouse gases. According to the U.S. Environmental Protection Agency (EPA), methane is more than twenty times more effective at trapping heat in the atmosphere than carbon dioxide over a hundred-year period. The EPA states that methane's relatively short atmospheric lifetime, coupled with its potency as a greenhouse gas, makes it a candidate for mitigating global warming over the near term. Virginia has been a leader in reducing emissions of methane from coal-mining operations. Approximately 80 billion cubic feet of methane were capture from coal seams in 2006. This is nearly enough to provide natural gas to all residential users in the state. Methane emissions have also been reduced through local natural gas utility pipeline repair programs and increased recovery of landfill gas.

Methane emissions also can be reduced through waste management practices. Increasing waste-to-energy development keeps waste out of landfills and reduces methane formation. Implementing new landfill gas to energy projects will capture methane otherwise vented to the atmosphere or burned in flairs, creating useful energy out of this wasted resource.

The Energy Policy Act of 2005 is the most recent major federal legislation that, in part, should lead to decreased greenhouse gas emissions. The act requires use of cleaner burning alternative fuels, federal purchases of renewable electricity, and higher efficiency standards for selected energy-using products. It provides tax incentives to promote alternative fuels, efficient vehicles, renewable and nuclear electricity, efficient buildings, and clean-coal technologies.

A growing number of states are adopting policies aimed at reducing greenhouse gas emissions, among them renewable portfolio standards for electric generation, fiscal incentives (tax benefits, rebates, grants, and loans) for energy-efficiency and renewable-energy measures, enhanced building energy standards, greenhouse gas inventory and registry activities, carbon cap and trade programs, and other measures.

Virginia has begun to address greenhouse gas emissions, but it has the potential to do more. Virginia adopted a voluntary renewable portfolio standard early in 2007. Additionally, on May 22, 2007, Governor Kaine announced that Virginia had joined The Climate Registry. With a membership of more than thirty states and several tribes, The Climate Registry is the

On May 22, 2007, Governor Kaine announced that Virginia had joined The Climate Registry. With a membership of more than thirty states and several tribes, The Climate Registry is the nation's only state-sponsored initiative to standardize methodologies to record and measure greenhouse gas emissions such as carbon dioxide, methane, and nitrous oxides.

nation's only state-sponsored initiative to standardize methodologies to record and measure greenhouse gas emissions such as carbon dioxide, methane, and nitrous oxides. The Climate Registry is intended to provide "an accurate, complete, consistent, transparent and verified set of greenhouse gas emissions data from reporting entities, supported by a robust accounting and verification infrastructure."[85]

Implementation of 2007 electric utility legislation will also result in reduced greenhouse gas emissions. Meeting the 10 percent electric conservation goal in the 2007 electric legislation would be equivalent to reducing more than 7 million metric tons of carbon dioxide emissions, or approximately 5.5 percent of the estimated 130 metric million tons of 2005 total carbon dioxide emissions. Meeting the 12 percent renewable portfolio standard goals for Virginia's investor-owned utilities would result in a similar reduction in carbon dioxide emissions. A 10 percent reduction in gasoline use in Virginia would reduce carbon dioxide emissions by nearly 4 million metric tons per year, or approximately 3 percent of Virginia's total 2005 carbon emissions.

The recommended actions in this Plan for increased energy efficiency, methane emission reductions, and switches to lower-carbon fuels are a start toward controlling greenhouse gas emissions. However, these actions alone will not solve the problem of increasing carbon dioxide emissions.

Virginia can join other states in setting an aggressive goal to reduce greenhouse gas emissions by 30 percent by 2025. This will bring Virginia's greenhouse gas emissions back to 2000 levels. The question of how Virginia will reach this goal requires exploration that is beyond the scope of this Plan. Therefore, the Commonwealth should create a Commission on Climate Change. The commission could be asked to make a more comprehensive assessment of greenhouse gas issues and develop a plan for how to reach this greenhouse gas emission reduction goal. Specifically, the commission could be charged with preparing a Climate Change Action Plan that would (i) calculate the size of and contributors to Virginia's carbon footprint, (ii) address the effects of increasing atmospheric greenhouse gas concentrations on the state, (iii) identify what Virginia needs to do to prepare for the likely consequences of climate change, and (iv) identify what actions are needed to meet goals for reducing greenhouse gas emissions.

To help calculate the size of Virginia's carbon footprint, the state could go beyond voluntary participation and require reporting of greenhouse gas emissions through The Climate Registry. This would establish hard data needed to look at specific areas where carbon is emitted and help identify where reductions are possible.

This issue should be the subject of national policy because both the causes of, and solutions to, climate change transcend state and local boundaries. But, the magnitude of the problem is such that states can not simply wait for a federal resolution. It is hoped that these recommendations, and similar actions taken by other states and localities, may motivate a comprehensive national approach to this topic. Virginia stands willing to participate in the develop of such an approach and will work to harmonize our efforts with a reasonably aggressive national strategy.

5.2 Impacts of Energy Use on Air Quality

Energy production and consumption are significant factors in Virginia's air quality challenges. Burning fossil fuels to generate electricity and to power transportation systems is the predominant contributor of pollutants to the atmosphere. In 2005, fuel combustion accounted for the overwhelming majority of the 291,635 metric tons of sulfur dioxide, 125,189 metric tons of nitrous oxides, and 1 metric ton of mercury emitted by Virginia utilities and industry. It also accounted for a substantial percentage of particulate matter, volatile organic compounds, and hazardous air pollutants.

[85] The Climate Registry, www.theclimateregistry.org.

Virginia adopted the Clean Air Interstate Rule and mercury rules capping emissions of sulfur dioxide, nitrous oxides, and mercury. Any new sources of these pollutants must be offset so there will be no net increase in the emissions.

Emission of these pollutants is regulated by the state under the federal Clean Air Act. Air quality permits are issued to industries and facilities that emit regulated pollutants to ensure that these emissions do not harm public health or cause significant deterioration in areas that have clean air. As part of this regulatory regime, Virginia adopted the Clean Air Interstate Rule and mercury rules capping emissions of sulfur dioxide, nitrous oxides, and mercury. Any new sources of these pollutants must be offset so there will be no net increase in the emissions.

The three population centers of northern Virginia, Richmond, and Hampton Roads are most affected by air pollution nonattainment designations. As of July 2007, nine full or partial counties were designated as nonattainment for the federal fine particulate matter standard. Until May 29, 2007, sixteen full or partial counties in Virginia were designated as nonattainment areas for the federal eight-hour ozone air-quality standard.[86] On that date, the U.S. Environmental Protection Agency announced that air quality in Richmond and Hampton Roads meets the federal standard to protect people's health from ozone pollution. The federal agency took the action after determining that air quality in the two areas has improved since the initial nonattainment designation.

Current and projected population growth and industry expansion suggest that Virginia faces challenges in balancing energy demands with environmental concerns. Issues associated with global warming have led governments, businesses, and individuals to examine ways to alter policies, strategies, and lifestyles to reduce emissions of greenhouse gases. Approaches such as renewable-energy use, energy efficiency and conservation, mixed use/high-density land-use planning, mass transit, recycling/waste-stream reuse, telecommuting, and driving hybrid and other fuel-efficient vehicles are all becoming mainstream and will play a key role in addressing the challenge.

5.3 Impacts of Energy Use on Water Quality and Water Supplies

The energy-use impacts on water quality and supply that are of greatest concern in Virginia are mercury, nutrient, and acid deposition and water heating and evaporation. Energy extraction and production also affect water quality and availability of water supplies. The Department of Environmental Quality (DEQ) and Department of Mines, Minerals and Energy regulate most of these impacts through their permitting processes and by setting limits to protect water quality and quantity. Energy production also can affect aquatic water habitat by altering flow regimes, obstructing fish migration and causing sedimentation.

5.3.1 Mercury Deposition

Mercury from power plant emissions can be deposited into rivers and streams by rain and ultimately accumulates in fish. Mercury accounts for a large percentage of all Virginia state advisories on reduced fish consumption. As of December 31, 2005, there were twelve mercury-impaired waters in Virginia.[87] In all but two,[88] air deposition is suspected as a significant or the sole source of the contamination. The Virginia Department of Health has issued mercury-based fish-consumption advisories for portions of all ten of Virginia's river basins, based on fish-tissue monitoring.[89] The U.S. Environmental Protection Agency (EPA) and the Food and Drug Administration have issued seafood-consumption advisories because of mercury levels found in certain marine species.

Recognizing that mercury emissions are transported long distances, the EPA issued the Clean Air Mercury Rule to reduce emissions from coal-fired utilities and to help states meet their water-quality goals. States were required to submit a rule by fall 2006 to implement the federal reductions. The State Air Pollution Control Board adopted these rules in January 2007. The rules capped mercury

[86]Virginia Ambient Air Monitoring 2005 Data Report, Virginia DEQ, p. 69.
[87]Virginia Water Quality Assessment 305(b)/303(d) Integrated Report, September 2006, pp. 3.1-9-3.2-54.
[88]Mercury impairments in the North Fork of the Holston River in southwest Virginia and in the Shenandoah/South Rivers in the valley region are due to legacy point source from industrial activities.
[89]Virginia Water Quality Assessment 305(b)/303(d) Integrated Report, September 2006, p. 2.4-12.

emissions so new emissions must be offset, and restricted trading allowances more than the minimum required under the federal Clean Air Mercury Rule. The DEQ is conducting a study, scheduled for completion by fall 2008, to determine the effects and sources of mercury deposition in state waters and whether or not additional controls are needed.

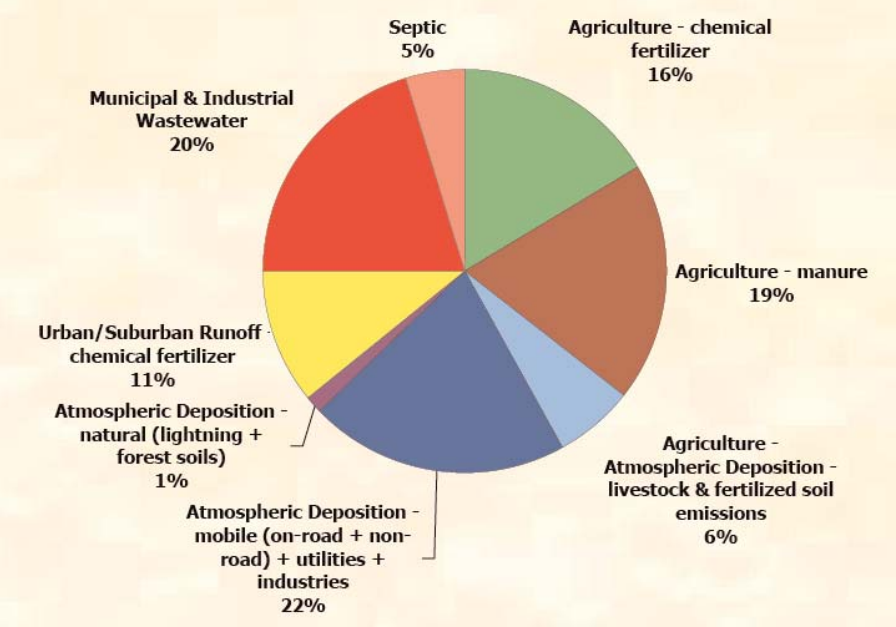
5.3.2 Nutrient Deposition

Major portions of Chesapeake Bay and its tributaries are listed under the Clean Water Act as "impaired" because of such factors as low dissolved-oxygen levels, poor water clarity, and algae blooms. Caused by excess nitrogen and phosphorus loads, these conditions severely stress the bay's ecosystem and hinder commercial fishing, recreational use, and aesthetic enjoyment of the bay and its tributaries. The EPA's Chesapeake Bay Program Office estimates that in 2005, 22 percent of the nitrogen load in the bay and its tributaries came from air deposition from mobile source, industrial, and electric utility emissions (see Figure 5-1). The remainder came from point sources such as discharges from wastewater treatment plants and industrial facilities and non-point sources such as urban, suburban, and agricultural runoff.

The State Air Pollution Control Board has recently adopted regulations to implement the federal Clean Air Interstate Rule that will cap and eventually reduce nitrous oxide emissions and impacts from power generation. Virginia has also instituted regulatory controls on point-source dischargers and has invested hundreds of millions of dollars to reduce point-source and non-point-source nutrient discharges to the Chesapeake Bay and its tributaries. Additional nutrient-reduction measures, especially for non-point sources, will be needed to achieve restoration of the bay and its tributaries.

Major portions of Chesapeake Bay and its tributaries are listed under the Clean Water Act as "impaired" because of such factors as low dissolved-oxygen levels, poor water clarity, and algae blooms. Caused by excess nitrogen and phosphorus loads, these conditions severely stress the bay's ecosystem and hinder commercial fishing, recreational use, and aesthetic enjoyment of the bay and its tributaries.

Figure 5-1 Sources of Nitrogen Loads to Chesapeake Bay, 2005



Total Nitrogen Loads to the Bay in 2005 = 266 million lbs./year

5.3.3 Acid Deposition

Acidic compounds are formed in the atmosphere when sulfur dioxide and nitrous oxide pollutants, released primarily from burning fossil fuels, react with other substances in the atmosphere. These compounds can be deposited on land and water by rain, fog, snow, or dust. Acidification of soil and vegetation damages forests and crops by making them more susceptible to disease. Acid

[90]See the EPA's website: www.epa.gov/region7/programs/artd/air/acidrain/acidrn2.htm.

Transportation is Virginia's largest energy-consuming sector. Land use and transportation are integrally linked. The typical suburban sprawl that characterizes much of Virginia's urban crescent increases the demand for new roads and highways. This style of development intensifies automobile use and discourages the use of less polluting alternatives such as public transit, bicycling, or walking.

deposition contributes to the deterioration of buildings and monuments. Acidic aerosols are known to worsen asthma and other lung ailments and to impair visibility in many regions, including the scenic vistas of our national parks.[90]

Increased water acidity and metals leached from acidified soil can impair the ability of certain types of fish and aquatic plants to reproduce, grow, and survive. Streams in the Appalachian Mountain region have lost trout and other aquatic life because of acid deposition.

In the preamble to the Clean Air Interstate Rule in the Federal Register (2005), the EPA stated that activities to reduce sulfur dioxide and nitrous oxide emissions from coal-fired utilities will result in environmental benefits, such as reducing nutrient deposition that leads to excessive aquatic plant growth and eutrophication and reducing acidification of lakes, streams, and forests. Preventing pollution, reducing tailpipe emissions, and reducing emissions from power generation and industrial processes are the recommended actions for curbing acid deposition.

Virginia has several specific initiatives to control acid deposition, including:

- Title IV utility controls (Phase II) – Large Virginia power plants were required to reduce sulfur dioxide and nitrous oxide emissions beginning in 2000 and to participate in a federal sulfur dioxide trading program.
- Low-sulfur gasoline and diesel fuel – Phased in for on-road and off-road vehicles starting in 2006.
- Clean Air Interstate Rule – Additional large sulfur dioxide reductions from power plants are expected in 2009 and 2010.
- New federal emission regulations for off-road vehicles, trains, and marine engines will be phased in over the next five to ten years. Some regulations have been adopted and some are currently proposed.

5.3.4 Water Heating and Evaporation

Power generation and energy use contribute to water-supply challenges in Virginia, where population and economic growth are increasingly stressing a finite fresh water supply. Steam generation and cooling processes in power plants use billions of gallons of water each year from Virginia's surface waters and groundwater. Although most of this water is returned to surface waters, a significant portion is lost to evaporation.

Water resources are very limited in most of Virginia for any type of intensive water-consuming project. The pressures of a growing population and expanding industrial operations will continue to tighten water supplies in more regions of the state, reducing the water available for energy production. Emerging technologies and alternative energy sources can help reduce these impacts. For example, the Virginia City Hybrid Energy Center being developed in Wise County will use air-cooling technologies to significantly reduce water use.

5.4 Land Use and Energy Consumption

Electrical generating facilities require large tracts of land. They also require rail, barge, and pipeline infrastructure for fuel delivery, transmission lines, and waste storage and disposal facilities. As demand for electricity continues to grow, so does the challenge of finding appropriate sites and acquiring rights-of-way.

Extraction of coal, oil, and natural gas also has an effect on Virginia's landscape. The most significant impacts are those associated with surface coal mining. Surface mining operations in Virginia are expected to decline over the term of this Plan; projections suggest most future production will come from underground operations.

Transportation is Virginia's largest energy-consuming sector. Land use and transportation are integrally linked. The typical suburban sprawl that characterizes much of Virginia's urban crescent increases the demand for new roads and highways. This style of development intensifies automobile use and discourages the use of less polluting alternatives such as public

[91]Southern Environmental Law Center, "Where Are We Growing? Land Use and Transportation in Virginia," based on original data from U.S. Census Bureau, USDA Natural Resources Inventory, and Federal Highway Administration, 2002 (www.selcva.org/publications/va_growth_report.pdf)

From 1980 to 2000, Virginia's population grew 33 percent, while vehicle miles traveled grew 99 percent.

High-density, mixed-use "new urbanism"-style developments are gaining popularity. These communities offer live-work-play lifestyles where walking or biking to work or to shop is easy, convenient, and safe.

transit, bicycling, or walking.

From 1980 to 2000, Virginia's population grew 33 percent, while vehicle miles traveled grew 99 percent. From 1992 to 1997, a 7 percent population increase in Virginia was accompanied by a 15 percent increase in land development.[91] Virginia's trend toward sprawl and demand for transportation of people and freight is projected to grow at a similar pace for at least the next decade.

Sprawl impacts land, water, and air through increased utility infrastructure, energy use, and traffic. Policies aimed at changing land-use patterns would reduce energy use and the need for new electric and natural gas infrastructure, including power plants, transmission lines, and pipelines. Long-term land-use changes aimed at creating denser, mixed-use settlements offer considerable energy-saving opportunities. Focusing developers' attention on pedestrian and bicycle accommodations and public transit is also important.

Virginia's 2007 transportation legislation included measures that build on the previous reforms in transportation and land-use planning by expanding the scope and application of transportation impact fees for by-right commercial and residential development in communities with growing populations. This will promote more energy-efficient development by helping check unfettered sprawl and promote infill development. Other legislation enacted in 2007 strengthened standards for accepting subdivision streets into the state system by increasing connectivity standards for roads and subdivisions, enhancing the overall capacity and efficiency of the transportation network. Other legislation promoted traffic flow and interconnectivity on the state's road system, ensuring that new and existing roadways are not degraded by the creation of too many and poorly spaced intersections, turn lanes, median breaks, and other impediments and allowed Virginia Department of Transportation vehicles to participate in clearing cars and restoring traffic flow after an accident, improving response time. These traffic flow enhancements will reduce fuel use due to highway congestion.

High-density, mixed-use "new urbanism"-style developments are gaining popularity. These communities offer live-work-play lifestyles where walking or biking to work or to shop is easy, convenient, and safe. Many of the developments are incorporating a range of sustainability initiatives, from high-efficiency building-construction standards to water, wastewater, and solid waste handling and use. More recently, developers and property owners are showing an interest in community-based power generation where small, distributed units would be co-located with or sited close to a community to provide power to residents and businesses or to be sold back to the grid. This also provides for an attractive market for renewable-energy applications. In Virginia, examples include Haymount in Caroline County, Rocketts Landing in Richmond, and New Town in Williamsburg. Plans for the Town of Haymount, for example call for approximately 12,000 people, 4,000 homes (which will use green building products), 250,000 square feet of retail space, 500,000 square feet of commercial and light industrial space, churches, parks, schools, and an organic farm. Only a third of the land will be developed, with the rest remaining in forests, wetlands, and farming areas.

Although not a new urban development, Tangier Island is an example of a self-sufficient community. The community is considering installing utility-scale wind turbines to supplement and replace much of the power purchased from the mainland or coming from on-island diesel generator sets. If implemented, this would provide a model for a small community co-op that others could learn from and replicate.

Redevelopment of urban brownfield properties and inner-city districts can have the same positive impacts on energy and the environment while also creating jobs, revitalizing neighborhoods, increasing property- and sales-tax revenues, decreasing sprawl, and reducing health risks to the local community. Redevelopment can be

transit oriented by developing around transit stops and including retail and commercial so that people can meet daily needs by foot, bicycle, or public transportation. Arlington County's land-use plans along metro routes in the county are a good example of compact, transit-oriented urban development.

5.5 The Environmental Case for Energy Efficiency and Renewable Energy

5.5.1 Energy Efficiency

Using energy more efficiently, whether through more efficient end uses or generation, reduces the amount of fuel required to produce a unit of energy. This in turn reduces emissions of greenhouse gases and other pollutants.

Efficiency measures can also save substantial amounts of water in electrical generation and in homes, offices, and industrial facilities. For example, a new high-efficiency clothes washer uses 4,500 gallons less water a year than a standard-efficiency washer.[92]

A January 2007 report prepared by the State Advisory Board on Air Pollution states that energy efficiency can slow the growth in electric demand and moderate the associated price volatility, energy security concerns, and environmental impacts.[93] The report notes that the United States now saves "more energy each year from energy efficiency than we get from any single energy source."[94]

A January 2007 report prepared by the State Advisory Board on Air Pollution states that energy efficiency can slow the growth in electric demand and moderate the associated price volatility, energy security concerns, and environmental impacts.[93] The report notes that the United States now saves "more energy each year from energy efficiency than we get from any single energy source."[94] An added advantage of energy-efficiency improvements is that they typically can be implemented quickly.

5.5.2 Biofuels Production

According to the June 2004 Chesapeake Bay Watershed Blue Ribbon Finance Panel, "virtually all of the [Chesapeake Bay] basin's more than 87,000 farms will need to implement additional best management practices (BMPs)-well beyond those now in place-to meet current goals for reducing nutrient and sediment loadings to the Bay and its tributaries….Nitrogen originates from both inorganic fertilizer and manure and is a particular concern in corn, wheat and soybean production due to inefficient nitrogen uptake in those large-scale crop operations."[95] Increased acreage of row crops such as corn or soybeans planted in response to ethanol or biodiesel demand can make this problem worse. It is also possible that farm acres currently devoted to implementing conservation practices could be converted to corn production. Growing other biofuel crops, such as hull-less barley or cellulosic crops, can, with best management practices, reduce nutrient runoff. Best management practices should be followed on any lands used to produce energy crops to avoid harming water quality.

Best management practices also could include capturing nutrients and using them as a catalyst to breed new biomass alternative fuel feedstock. The Virginia Coastal Energy Research Center is researching algae biomass-to-energy technologies. Algae can be cultivated using nutrients from manure digesters or through photo-bioreactors that harvest nutrients from irrigation runoff.

Algae species can be selected to make a variety of products, including lipids for biodiesel, proteins for feed, and carbohydrate biomass for fuels. Lipid-rich algae, for instance, can be pressed to extract oil for conversion to biodiesel in a manner similar to that used for soy-based biodiesel production. The resulting protein- and carbohydrate-rich meal has animal feed potential. If cellulosic ethanol production advances, algae can also serve as a feedstock for ethanol fuel. Virginia has a favorable climate for algae production, with a long photoperiod, ample sun, warm temperatures, and nutrient-rich waters that could be intercepted from critical points in key watersheds with strategically placed photo-bioreactors. It may be possible to use new tax revenues from an alternative fuels industry to help fund nutrient-reduction best management practices.

Biofuel production in Virginia offers additional positive environmental impacts. Virginia production would result in the

[92]American Council for an Energy Efficient Economy, "Consumer Guide to Energy Savings," 8th ed., 2003, www.aceee.org/consumer-guide/index.htm.
[93]State of Virginia, "Report from the Greenhouse Gas Working Group of the State Advisory Board on Air Pollution," January 5, 2007, p. 46.
[94]Ibid.
[95]www.chesapeakebay.net/pubs/blueribbon/Blue_Ribbon_fullreport.pdf.

increased end-use of these products, thus replacing higher polluting conventional fuels. Production plants would also need agricultural feedstock, creating potential new markets for Virginia farmers, which could preserve our rural heritage by providing an economic alternative to converting farmland to development.

5.5.3 Renewable Electricity Production

Electricity from renewable resources such as solar, geothermal, and wind technologies generally does not contribute to global climate change or local air pollution since no fuels are combusted in these processes.[96] Such low-emission renewable resources emit few or no pollutants and require little or no water for system operation. Biomass use does entail air pollution releases such as sulfur dioxide, but they are reduced relative to other energy sources. Biomass can be carbon neutral if grown to absorb at least as much carbon dioxide during growth as is released by combustion.

State-based standardized calculations that relate electricity production and use to emission rates have been developed based on the generation mix for each state. For every kilowatt-hour saved through efficiency or displaced by an emission-free renewable source, a considerable amount of emissions can be offset. Table 5-1 provides the factors calculated for Virginia per kilowatt-hour (kWh) and megawatt-hour (MWh).[97] These are average factors because different electrical generating units with different rates of emissions are operated at different times based on customer power demand and economic and technical considerations.

A renewable portfolio standard is a policy tool that requires or encourages retail sellers of electricity to provide a minimum portion of their electricity from renewable resources.

Table 5-1 Average Factors for Virginia Electricity Emissions, 2002

CO_2			CH_4	N_2O
lbs/kWh	short tons/MWh	metric tons/MWh	lbs/MWh	lbs/MWh
1.16	0.582	0.528	0.0137	0.0192

5.6 Incentives for Renewable Energy

5.6.1 Renewable Portfolio Standard

Many states have programs to provide financial and policy incentives for developing renewable resources. A renewable portfolio standard is a policy tool that requires or encourages retail sellers of electricity to provide a minimum portion of their electricity from renewable resources. Renewable portfolio standard requirements are typically denoted as a percentage of electricity sold to retail customers and are achieved by phased-in increases in the target percentage over time.

Although Congress has considered requiring a federal renewable portfolio standard, to date all enacted such standards have been adopted at the state or local level by state legislation or regulatory initiative. As a result, the resources eligible for renewable portfolio standard vary from state to state. More than twenty states have now passed a standard or similar requirement, with each state developing rules customized to its own regulatory and market environment.

Electric utility restructuring legislation passed in the 2007 Virginia General Assembly established a voluntary Virginia renewable portfolio standard. The standard is available for electric utilities that show a reasonable expectation of achieving 12 percent of base-year electric energy sales from renewable energy sources by 2022. Under the program, a utility that meets renewable energy goals earns an incentive that increases the established rate of return. It also earns an enhanced rate of return on the construction costs of renewable energy generation

[96]EPA, Clean Energy-Environment Guide to Action, April 2006, p. 50 (www.epa.gov/cleanenergy/pdf/gta/guide_action_full.pdf).
[97]Source: Voluntary Reporting of Greenhouse Gases Program, Energy Information Administration.

Electric utility restructuring legislation established a voluntary Virginia renewable portfolio standard available for electric utilities that show a reasonable expectation of achieving 12 percent of base-year electric energy sales from renewable energy sources by 2022.

facilities used to provide the renewable energy. Electricity generated from solar or wind is given double credit toward the goal.

5.6.2 Other Incentives

In 2006, Virginia created a Photovoltaic, Solar, and Wind Energy Utilization Grant Program. The program would grant up to 15 percent of the cost of eligible systems, up to $2,000 for photovoltaic systems, or $1,000 for solar water heating or wind-power systems. Legislation also included a Renewable Electricity Production Grant Program that would grant up to 0.85 cents for each kilowatt-hour of electricity produced from approved renewable energy generators. Both of these programs are subject to appropriation and as of summer 2007 had not received funding.

Virginia offers several incentives to help overcome cost barriers to the use of renewable energy. Counties and localities have been given the authority to exempt, or partly exempt, the cost of solar energy equipment from the property taxes paid by homeowners each year.

Virginia also provides for "net metering," which allows customers to generate their own electricity (such as through the use of solar panels) and receive the full retail value for their excess electricity at times when their renewable energy system is producing more electricity than their building is consuming.

Localities may also establish a separate classification of real estate for properties that are at least 30 percent or more energy efficient than required by building code. The localities may then set a lower real-estate tax rate as an incentive to construct these energy-efficient structures.

A different type of incentive for energy efficiency and renewable energy (EERE) is provided in Virginia's implementation of the Clean Air Interstate Rule. The Virginia rule caps total nitrous oxide emissions from the state's electrical generating plants of at least 25-megawatt capacity. Such plants are allocated tradable allowances, each representing a ton of nitrous oxide that can be bought and sold, allowing flexibility in how electrical generators will achieve required statewide nitrous oxide reductions.

As enacted by the State Air Pollution Control Board, the rule incorporates a set-aside of allowances for new facilities as well as a special energy efficiency and renewable energy set-aside. Projects that displace at least a ton of nitrous oxide emissions can obtain such allowances, which can then be credited in air pollution State Implementation Plans or other air-quality regulatory processes.

Scenarios for use of energy efficiency and renewable energy allowances could include northern Virginia localities buying wind power or implementing energy-efficiency measures that are allocated nitrous oxide allowances, which can be retired and then recognized by the Environmental Protection Agency as evidence of the localities achieving creditable nitrous oxide reductions.

5.7 Carbon Capture and Storage

Carbon capture and storage is a topic that is generating considerable interest and has significant potential. The U.S. Department of Energy's Office of Fossil Energy supports carbon sequestration activities and identifies sources of emissions and suitable sites for storage, with a goal of reducing carbon dioxide emissions and preventing a projected one-third increase in U.S. emissions from 2005 to 2030. Developers of new technologies for power generation and alternative fuels are including carbon capture as prerequisites to their research and development platforms and in their plans for commercialization.

Aviation fuel for the Department of Defense represents the largest single market area for liquid fuels. The Department of Defense is actively pursuing synthetic replacements to JP-8 aviation fuel; and U.S. Air Force representatives have noted that for replacement fuels to be considered, carbon capture or carbon-free production

Although diversifying energy production and transitioning to cleaner alternatives will take time and money, energy conservation and efficiency can start now.

processes will be required.

Significant carbon sequestration research has been conducted under the Regional Carbon Sequestration Partnership program, which draws from seven regions in the United States and Canada and consists of more than four hundred organizations in forty states, four Canadian provinces, and three Indian nations. In March 2007, the partnership released the results of a survey that identified stationary sources (including power plants) that produce 3.8 billion tons of carbon dioxide each year, as well as sites with the potential to store more than 3,500 billion tons of carbon dioxide. Carbon sequestration involves capturing and storing carbon dioxide that would otherwise remain in the atmosphere for long periods of time. The carbon dioxide is stored in geologic formations, soils, and vegetation or other environmentally friendly forms.

Virginia Tech, a partner in the Southeast Regional Carbon Sequestration Partnership (SECARB), has researched and developed data on Virginia's potential and is testing carbon capture and storage technology in Virginia's coal seams. The project has the potential to implement a ten-year pilot to capture a million tons of carbon dioxide per year in Virginia. It also could increase the production of coalbed methane from the coal seams, increasing the efficiency of these operations (see Chapter 6).

5.8 Environmental Programs Affecting Energy Use

Changes in current patterns of producing and using energy can greatly reduce a variety of environmental problems, including emissions of greenhouse gases, conventional pollutants, and hazardous air emissions. Such changes can also reduce water use and water pollution.

Energy recovery can also address environmental concerns. For instance, energy recovery from gases generated in landfills, from sewage treatment, and in certain industrial processes can reduce air pollution, odor, greenhouse gas emissions, and explosive hazard. In such industries as agriculture and food production, treatment of wastes through energy recovery can yield useful energy, reduce disposal costs and nuisance from odor and other impacts, and perhaps derive concentrated nutrients or other saleable products.

Energy conservation and efficiency provide the least costly and most readily deployable energy-resource options and provide an immediate strategy to reduce the adverse impacts of energy production. Although diversifying energy production and transitioning to cleaner alternatives will take time and money, energy conservation and efficiency can start now. Carbon capture and storage technologies, clean-energy technologies, and efforts that reduce the environmental burden created by new energy infrastructure, current land-use patterns, and growing traffic-load trends represent longer-term approaches that can have significant positive energy and environmental impacts.

The Virginia Environmental Excellence Program (VEEP) is a voluntary program offering membership to government and non-government members. The program recognizes environmental achievements and encourages superior performance through environmental management systems and pollution prevention. It is closely aligned with the National Environmental Performance Track program, a voluntary partnership program run by the Environmental Protection Agency that recognizes top environmental performance among participating U.S. facilities. The program stresses continual environmental improvement through the use of environmental management systems, performance measures, and public outreach. Energy efficiency improvements should be an integral part of the VEEP actions.

On the local level, the Arlington Initiative to Reduce Emissions is a collaborative effort between the county government, businesses, organizations, and individuals that calls for a commitment to reduce greenhouse gas emissions by 10 percent by 2012.[98] As of July 2007, seven Virginia

[98]See www.arlingtonva.us/portals/topics/Climate.aspx.

mayors were participating in the U.S. Mayors Climate Protection Agreement. Fairfax County has been a leader in developing the Cool Counties Climate Stabilization Declaration.

Voluntary organizations, such as the Chicago Climate Exchange and the U.S. Climate Action Partnership (which includes major companies and environmental organizations), support and administer emission reduction plans.

5.8.1 Virginia Programs

Virginia Clean Air Interstate Rule

Numerous counties and cities in Virginia have been designated as nonattainment areas for the National Ambient Air Quality Standard for ozone and for fine particulate matter. In late 2006, the Virginia Air Pollution Control Board adopted regulations to implement the federal Clean Air Interstate Rule. These regulations reduce future emissions from power plants of sulfur dioxide and nitrous oxides-precursors to ground-level ozone and particulate matter-to a greater extent than the minimums required under federal rules. As described previously, these regulations also provide a new mechanism to reduce emissions by allocating nitrous oxide allowances to spur energy efficiency and renewable energy projects and requiring that such allowances be retired.

EERE Measures in the Virginia State Implementation Plan

Under the Clean Air Act, Virginia is required by June 2007 to submit additional control measures to help bring its air quality into attainment with the 8-hour ozone standard. As part of this Plan, municipalities in northern Virginia, including Arlington, Fairfax, and Prince William Counties and the Alexandria City School District, have proposed quadrupling the wind-energy purchases included in Virginia's 2004 ozone State Implementation Plan. They have also included energy-efficiency measures for the first time, including retrofitting traffic signals with high-efficiency light-emitting diode (LED) bulbs.

High Electric Demand Day Initiative

On March 2, 2007, the Ozone Transport Commission-an organization of state environmental commissioners in the Northeast and Mid-Atlantic States, including Virginia-adopted a resolution endorsing energy-efficiency and clean-energy strategies to combat high levels of ozone in the Northeast and Mid-Atlantic States. The goal is to intensify efforts among state air and energy agencies and utility regulators to adopt policies that reduce peak levels of electric power demand. Accomplishing this goal will not only improve air quality and public health but also will moderate electric price increases and improve reliability of the electric grid.

Clean Air Champions

The Department of Environmental Quality, in partnership with the American Lung Association, has developed a marketing campaign and curriculum to educate Virginians on the importance of keeping vehicles well maintained in order to protect air quality. This material has been incorporated in the Drivers Education Core Curriculum that is provided to approximately 80,000 students every year.

One of the challenges Virginia municipalities face with many of these efforts is the need to develop, refine, and implement methods to improve the quantification of energy savings and emissions reductions that result from energy-savings measures. This work is necessary to gain maximum benefits from the use of the new tools in the Virginia Clean Air Interstate Rule and to implement the governor's 2007 executive order requiring the calculation of greenhouse gas emission reductions resulting from energy-savings measures in public buildings. This work can be best accomplished through a collaborative effort among state environmental and energy agencies and the State Corporation Commission, with support from relevant federal agencies.

State Advisory Board on Air Pollution

The 2007 report from the Greenhouse Gas Working Group included a list of policy options that address energy. This list includes recommendations in energy

efficiency, transportation, industry, and energy production, many of which are reflected in this Plan.

5.8.2 Other Approaches and Options

Many communities are taking action to reduce the environmental and energy burdens created by current land-use and development trends. Policies that promote smart growth and coordination of land use with transportation primarily involve planning, modeling, and regulatory tools that support local government efforts. They include tax measures, impact fees, new zoning ordinances, and regional or statewide growth management planning. State-supported investments in roads, public buildings, and other local development-related costs could be leveraged in order to make progress toward smart-growth communities. Using open-space protection programs, policies can discourage sprawl and greenfield development. Typical actions include:

- Localities and planning commissions addressing energy effects of land-use plans.
- Local planning and zoning commissions adopting measures such as transportation and infrastructure planning, transit-oriented development, and housing diversity.
- Statewide policies supporting land conservation, regional mass transit, property-tax reform, and building energy codes.

Many communities are taking action to reduce the environmental and energy burdens created by current land-use and development trends. Policies that promote smart growth and coordination of land use with transportation primarily involve planning, modeling, and regulatory tools that support local government efforts.

Several programs already exist in Virginia. Expanding the state's role and increasing the level of participation by local governments and businesses is a low-cost option.

For local governments:

- Clean Cities (offered in Virginia through the Hampton Roads Clean Cities Coalition).
- Rebuild America (offered in Virginia through the Virginia Sustainable Building Network).
- U.S. Mayors Climate Protection Agreement.
- Cool Counties Climate Stabilization Declaration.

For business and industry:

- U.S. Climate Action Partnership (industry and environmental group partnership).
- Climate Leaders and Climate Wise (EPA).
- U.S. Department of Energy's voluntary Reporting of Greenhouse Gas and Emission Reductions Program.
- Industrial Technologies Program (DOE).
- Energy Star (EPA).
- Virginia Environmental Excellence Program (Virginia DEQ).
- SF6 Reduction Program (EPA and electric power industry collaborative).
- AgStar, Gas Star, Combined Heat & Power Partnership, Landfill Methane Outreach Program, Coalbed Methane Outreach Program, Methane-to-Markets (EPA and various business sectors).
- Industry-specific partnerships such as The PowerTree Carbon Company, LLC.

Promoting a green campus initiative with colleges, universities, and secondary schools can minimize environmental impact and create learning labs for sustainability. This program would develop and support an effective process to promote energy and environmental sustainability with educational institutions, while introducing and educating future decision makers and social pioneers on energy and sustainability issues.

Tree planting is a primary means of enhancing total carbon sink capacity. Programs encouraging tree planting can be effective in both rural and urban settings. Existing programs address a range of goals, such as habitat conservation, scenic values, and wildlife corridors. Afforestation and urban tree planting programs can yield low-cost carbon sequestration.

A branding program can increase consumer preferences for products and services that decrease greenhouse gas emissions and/or mitigate climate change impact. The federal government could expand the Energy Star brand to include more products. Alternatively, Virginia could partner with the private sector to

promote environmentally preferable products, recycled content, and other green goods and services. Retailers such as Home Depot, through its Eco Options program, are already offering such products.

Another way to address emissions from mobile sources would be to create a feebate program. Such a program would charge a fee on purchases for vehicles that are below specified fuel-efficiency and emission-performance criteria and offer a rebate on vehicles that exceed the criteria. The program could be designed in several different ways, taking into account the classes of vehicle to be covered and the manner in which the fees and rebates are calculated, collected, and disbursed. A feebate system can also be designed to either generate revenue or to be revenue neutral.

A branding program can increase consumer preferences for products and services that decrease greenhouse gas emissions and/or mitigate climate change impact. The federal government could expand the Energy Star brand to include more products. Alternatively, Virginia could partner with the private sector to promote environmentally preferable products, recycled content, and other green goods and services.